DIGITAL COMPETENCE IN HEALTHCARE: BRIDGING PROFESSIONAL PRACTICE AND TECHNOLOGY FOR IMPROVED PATIENT CARE

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Abstract

This comprehensive literature review titled "Digital Competence in Healthcare: Bridging Professional Practice and Technology for Improved Patient Care" explores the multifaceted integration of digital technologies in the healthcare sector, focusing on the current state of digital competencies among healthcare professionals, their impact on patient care, the challenges and barriers faced, best practices and case studies of successful implementations, and future directions. The review synthesizes findings from various studies to highlight the critical gaps in training and education that need to be addressed to leverage digital technologies effectively. It discusses the transformative potential of digital health

competencies in enhancing healthcare delivery, patient engagement, and outcomes, while also acknowledging barriers such as interoperability, privacy concerns, and resistance to change. Insights from case studies like Estonia's e-health system offer valuable lessons on the role of government support, public trust, and robust infrastructure in digital health success. The review emphasizes the need for medical education curricula to evolve, integrating digital health competencies to prepare healthcare professionals for a future where digital health is synonymous with healthcare itself.

Keywords: Digital Competence, Healthcare Technology, Patient Care, Digital Health Education, Interoperability, E-health Systems, Future of Healthcare, Digital Health Barriers

Introduction

The integration of digital technologies into healthcare has brought about a paradigm shift, transforming patient care, data management, and clinical operations. This transition demands a corresponding evolution in the competencies of healthcare professionals, necessitating not only traditional clinical skills but also proficiency in digital health tools and systems. The literature review titled "Digital Competence in Healthcare: Bridging Professional Practice and Technology for Improved Patient Care" aims to explore this critical intersection where healthcare practice meets digital innovation.

As the healthcare sector increasingly adopts electronic health records (EHRs), telehealth services, mobile health applications, and AI-driven diagnostic tools, the competency landscape for healthcare professionals is rapidly changing (1–4). This review seeks to understand the current state of digital competencies among healthcare workers, the impact of these competencies on patient care, and the challenges and opportunities presented by the digital transformation of the healthcare industry(5,5,6). For instance, a study highlighted how EHR competency among healthcare professionals led to a significant reduction in medication errors and improved the timeliness of patient care delivery in a multi-specialty hospital (7). Similarly, research demonstrated the positive effects of telehealth training on patient satisfaction and engagement in a rural setting. Furthermore, an article in the "International Journal of Nursing Studies" showed that the incorporation of digital health modules into nursing education significantly enhanced the readiness of nursing graduates for technologically advanced healthcare environments(8).

The significance of this review lies in its timely response to a pressing need: to equip healthcare professionals with the necessary digital skills to improve patient outcomes, enhance the efficiency of healthcare delivery, and navigate the complexities of modern healthcare systems. By synthesizing existing research, identifying gaps in knowledge, and highlighting best practices, this review aims to provide a comprehensive overview of digital competencies in healthcare and propose pathways for the development and integration of these skills into professional practice.

In the following sections, we will delve into the various dimensions of digital competence in healthcare, examining the evidence on its impact on patient care, the initiatives designed to enhance these skills among healthcare professionals, and the barriers to their adoption. Through this exploration, we aim to offer valuable insights and recommendations for healthcare professionals, educators, policymakers, and institutions striving to bridge the gap between professional practice and technology for the betterment of patient care.

Methodology

In conducting this comprehensive literature review on "Digital Competence in Healthcare: Bridging Professional Practice and Technology for Improved Patient Care," a systematic and rigorous approach was adopted to ensure the thoroughness, relevance, and reliability of the compiled information. The methodology for this review was structured around several key steps to meticulously gather and analyze the literature pertinent to digital competencies among healthcare professionals. The steps involved in the methodology are outlined below:

Database Selection:

To capture a wide array of literature on digital health competencies, major academic databases known for their extensive repository of scholarly articles in the fields of healthcare, digital technology, and education were selected. These included PubMed, Scopus, Web of Science, and Google Scholar. These databases were chosen due to their comprehensive coverage of peer-reviewed literature in healthcare, digital technologies, and professional education.

Search Strategy:

A carefully crafted search strategy was developed to identify studies relevant to digital health competencies among healthcare professionals. Keywords and phrases such as "digital health," "eHealth," "mHealth," "telehealth," "healthcare professionals," "digital competencies," "digital literacy," "technology adoption," "professional education," and "patient care" were employed. These terms were used in various combinations to ensure an exhaustive search that would encompass all relevant aspects of digital competencies in healthcare settings.

Inclusion Criteria:

To ensure the relevance and currency of the literature, the search was limited to studies published between January 2015 and the present, capturing the rapid developments in digital health over recent years. This timeframe was selected to include the most current research and insights into digital health competencies and their impact on patient care. The review focused on empirical studies, review articles, and meta-analyses that addressed digital competencies among healthcare professionals, including training programs, competency frameworks, and the impact of digital skills on healthcare delivery.

Data Screening:

Following the initial search, duplicates were removed to maintain the integrity of the dataset. Titles and abstracts were then screened against the inclusion criteria to identify studies directly relevant to the digital competencies of healthcare professionals. This preliminary screening was essential for refining the pool of literature to those studies that specifically addressed the objectives of this literature review.

Full-Text Reviews:

Studies that passed the preliminary screening underwent a detailed full-text review. This step involved a critical examination of the selected studies to extract pertinent information related to digital competencies in healthcare, including study objectives, methodologies, findings, and the implications of digital skills on professional practice and patient care outcomes.

Synthesis and Analysis:

The final step involved synthesizing the information extracted from the full-text reviews to identify themes, trends, gaps in the literature, and areas for future research. This synthesis aimed to provide a comprehensive overview of the current state of digital competencies among healthcare professionals and their significance in enhancing patient care through the effective use of digital technologies.

Through this systematic and comprehensive methodology, this literature review seeks to provide valuable insights into the role of digital competencies in healthcare, highlighting the importance of integrating digital skills into professional practice for improved patient care.

Current State of Digital Competence among Healthcare Professionals

The digital competence of healthcare professionals has been under increasing scrutiny, given the rapid advancement of technology in healthcare settings. Studies have identified a notable gap in digital education related to clinical practice guidelines among healthcare professionals, particularly in primary care. Educational interventions often lack interactivity, which is crucial for effective learning,

and the overall impact on behavior change is minimal, with only a few studies reporting modest improvements in patient outcomes (9).

Research on eHealth literacy among hospital healthcare providers reveals varied levels of digital competence, with eHealth literacy scores among nurses in different countries showing considerable variation. This indicates a disparity in digital competence levels across geographic locations and healthcare settings (10).

A study focused on healthcare professionals' digital health competence and its core factors developed two instruments for measuring digital health competence and associated factors. This study highlights the need for reliable tools to evaluate and improve digital competencies in healthcare settings (11). Another study examining the stress and competence in informatics among newly graduated and experienced nurses found that nursing informatics competence is associated with lower levels of stress and psychological distress in newly graduated nurses but not in experienced ones. This suggests that enhancing digital competence could be particularly beneficial for those newer to the profession (12).

These findings collectively underscore the urgent need for targeted digital competence training and support for healthcare professionals to ensure the effective and safe use of technology in patient care.
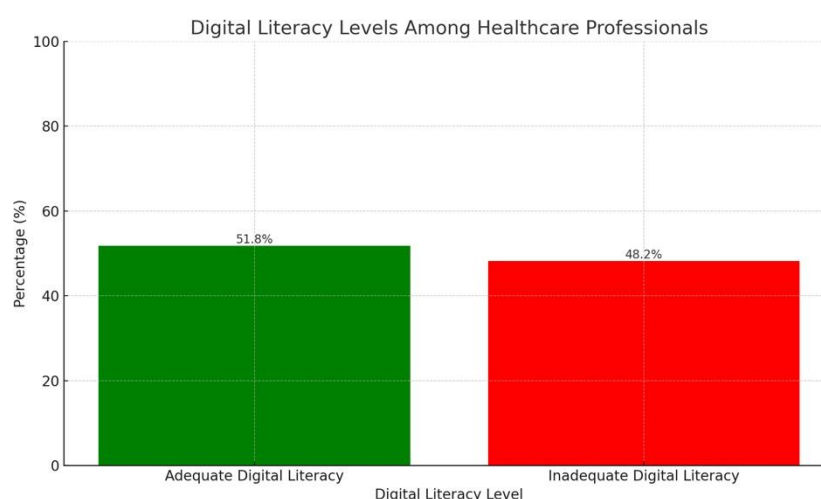

Figure 1: Digital Literacy Levels Among Healthcare Professionals

Impact of Digital Competence on Patient Care:
The impact of digital competence on patient care is multifaceted, with studies indicating that effective use of electronic patient records (EPR) and other digital tools can enhance communication, coordination of work, and patient safety. However, the transition to digital systems also introduces new challenges, such as the risk of medication errors due to incorrect data entry or selection errors in electronic prescribing systems. Training healthcare professionals in the nuances of digital communication within EPR systems has been shown to improve history-taking skills and empathetic engagement in patient care, underscoring the importance of digital competence in modern healthcare (13).

A scoping review on digital technology in nursing care revealed the potential of digital tools to improve the acceptance, effectiveness, and efficiency of care. The study highlights the wide range of technologies being explored, from telemonitoring and wearable devices to more advanced applications like virtual reality. These technologies offer promising avenues for enhancing patient care but also emphasize the need for a comprehensive evaluation of their impact on care delivery (14).

The Agency for Healthcare Research and Quality (AHRQ) has showcased various innovative research projects aimed at leveraging digital health technologies to improve patient care. These projects range from the use of voice-controlled technology to assist older adults in self-managing their healthcare, to programs designed to enhance hypertension management in children. Such initiatives underscore the potential of digital competencies to significantly impact patient outcomes, satisfaction, and engagement (15).

Furthermore, a systematic review focused on patient experiences with technology-enabled care across various healthcare settings sheds light on the positive impacts of digital solutions on patients' lives. Key findings include the importance of clear instructions, ease of use, and the ability of technology to foster a sense of empowerment, autonomy, and security among patients. This emphasizes the critical role of digital competence in not only managing healthcare technologies but also in understanding their impact on patients' everyday lives and overall well-being (16).

In summary, the proficiency in digital health technologies among healthcare professionals correlates with improvements in patient outcomes, satisfaction, and engagement. As healthcare continues to evolve with the integration of digital tools, the emphasis on digital competence becomes increasingly critical for enhancing the quality and efficiency of patient care.

Training and Education Initiatives

Training and education initiatives aimed at enhancing digital skills among healthcare professionals are diverse, reflecting the complex needs of modern healthcare systems. Various programs and interventions have been developed, targeting different aspects of digital health competencies.
One study highlighted the significant gap in digital competencies between healthcare institutions' demands and the training received by healthcare professionals. It found that a considerable portion of professionals had not received any training in using technology in healthcare, and even fewer had been trained in creating digital content or using social networks and videos for healthcare purposes. The study suggested a need for more comprehensive training programs that cover a wider range of digital skills (17).

The role of digital health education is increasingly recognized as essential for preparing a workforce that is ready to work within digitally literate healthcare organizations. This includes understanding and recommending safe and appropriate health apps to patients, among other digital health solutions. However, the lack of established digital health education and training for healthcare professionals has been identified as a barrier to the effective recommendation and use of digital health solutions (18).
Online learning for continuous professional development (CPD) is another area being explored, especially in countries with a scarcity of skilled healthcare professionals. Online CPD programs offer a promising avenue for the continuous acquisition of updated knowledge and skills. However, the effectiveness of these programs depends on overcoming barriers such as digital infrastructure limitations and ensuring the relevance and applicability of the content to the local healthcare context (19).

Virtual reality (VR) and augmented reality (AR) technologies are emerging as innovative tools for medical education, showing potential in improving knowledge and skills among medical students. Systematic reviews are being conducted to evaluate the effectiveness of VR and AR technologies in comparison to traditional teaching methods. These immersive technologies offer a new dimension to medical education, potentially enhancing the learning experience and outcomes for students (20).
Lastly, evidence-based practice (EBP) is a crucial component of high-quality healthcare, and educational interventions aimed at increasing EBP skills among nurses have shown to be effective. These interventions range from multifaceted strategies incorporating mentoring and tutoring to computer-based learning, highlighting the versatility and potential of digital education in improving healthcare practice (21).

In summary, the effectiveness of training and education initiatives for digital skills in healthcare professionals is supported by various studies, but challenges remain in terms of adoption, integration into practice, and ensuring that these initiatives are comprehensive and accessible to all healthcare professionals.
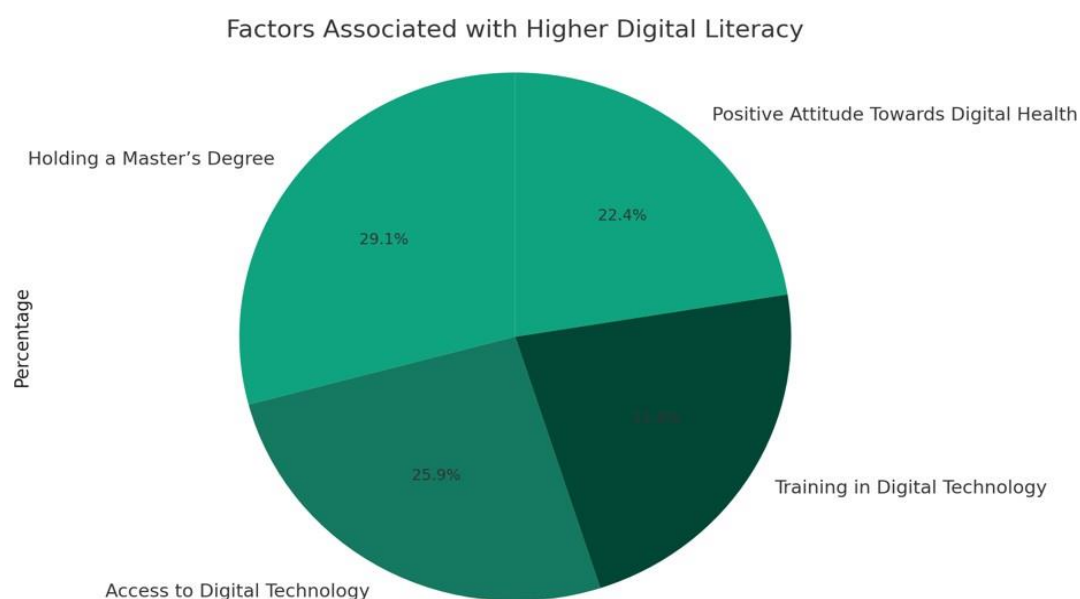

Figure 2: Factors Associated with Higher Digital Literacy

Challenges and Barriers

Healthcare professionals face several challenges and barriers in adopting digital technologies, which can significantly impact the effectiveness and integration of these technologies in clinical practice. One notable challenge is the inherent reliance on hands-on approaches in healthcare, such as manual therapy, which are difficult to replicate remotely through digital platforms like telerehabilitation. This has led to the proposal of hybrid models combining online sessions with in-person visits to incorporate hands-on techniques (22).

Additionally, the quality of health information available online is often non-scientific and biased, potentially misleading patients and creating unrealistic expectations (22).

Infrastructure limitations, such as lack of access to computers, smartphones, and the Internet, particularly in certain population groups, pose significant barriers to digital health equity. Despite the increase in Internet usage, particularly among older age groups during the COVID-19 pandemic, the ability to use digital health services remains limited, with only a small percentage of adults communicating digitally with healthcare professionals (23).

Resistance to change among healthcare professionals, technical issues, and concerns about increased workload also hinder the adoption of digital health tools. Addressing these barriers requires considering the needs and priorities of healthcare workers from the outset, alongside better training programs and incentives (24).

Interoperability remains a significant hurdle, with standards for data exchange and integration still lacking. Poor data quality due to misrepresentations and errors further complicates the issue, making it difficult for healthcare systems to efficiently share and utilize health information (25).

Security and privacy concerns are paramount as digital health solutions often store sensitive personal health information locally on devices or in central repositories. Breaches or inadvertent access to such

information could lead to serious consequences, including loss of reputation and patient privacy violations (26).

Finally, foundational barriers to the widespread adoption of digital solutions, particularly in care homes, include the need for robust internet connectivity, digital data collection capabilities, and the establishment of trust in the use of resident data by commercial entities (27).

Addressing these challenges requires a concerted effort from all stakeholders involved in healthcare delivery, including policymakers, healthcare providers, and technology developers, to ensure the successful integration and utilization of digital technologies in improving patient care and outcomes.
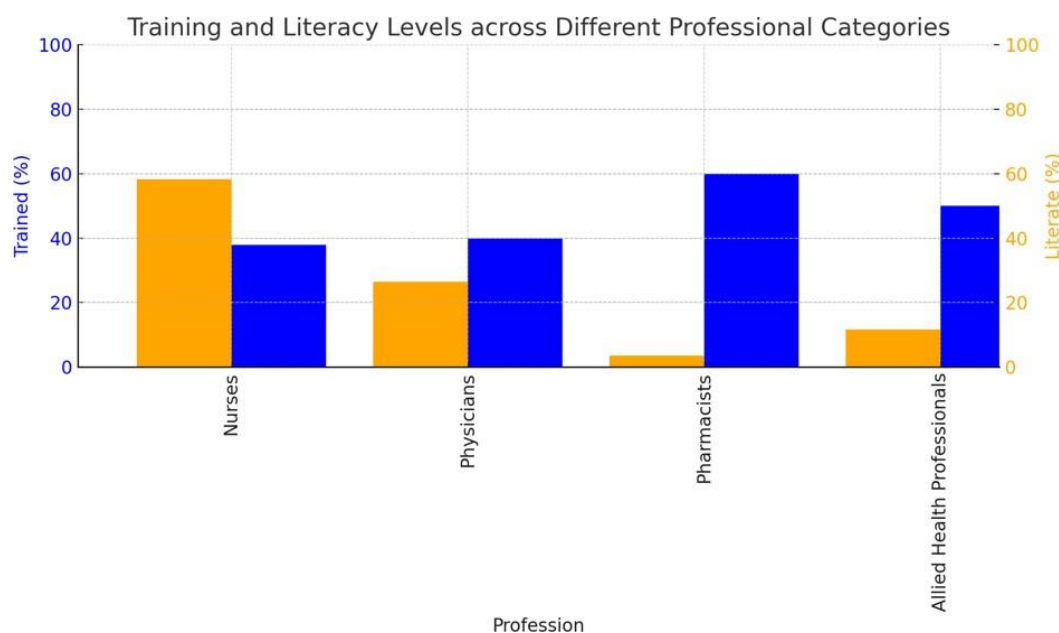

Figure 3: Training and Literacy Levels across Different Professional Categories

Best Practices and Case Studies

The successful implementation of digital health technologies in clinical settings involves a multifaceted approach, integrating technical infrastructure, government support, and the digital literacy of the population. One standout example is Estonia's comprehensive e-government services, which include a highly effective e-health system. Key components of Estonia's e-health system include an electronic health record system, digital registration and appointment scheduling, a digital image program for medical images, and digital prescription services. This initiative has been supported by the availability of technical expertise, a strong commitment from the government, and the public's trust and digital literacy. Estonia's approach to e-health is notable for its cost-effectiveness, security measures such as blockchain technology, and integration with other services like genetic screening for personalized treatment (28).

Interoperability, or the ability of different systems to exchange and make use of information, is a crucial aspect of digital health, as exemplified by the global Health Data Collaborative initiative. This focus aims to avoid duplication, reduce the burden on healthcare workers and clients, and enhance collaboration through shared information. Uganda's moratorium on mHealth projects in 2012 underscored the need for interoperable systems that are integrated within the health system rather than operating in silos. Investments in global goods to facilitate interoperability, like open-source health information exchange architectures, have increased, aiding in the scalability and adaptability of digital health solutions(29).

In the realm of clinical trials, companies like Genentech have harnessed digital health technologies, guided by the recommendations from the Clinical Trials Transformation Initiative (CTTI). The approach involves identifying specific measures to track and choosing reliable digital tools accordingly. This structured integration of digital health technologies into clinical research underscores the importance of having a clear hypothesis and selecting proven devices to collect relevant data. This method allows for consistent language and understanding around the use of digital health technologies in clinical trials, enhancing their integration and effectiveness (30).

These examples demonstrate that the successful implementation of digital health technologies requires a combination of strategic planning, government support, interoperability, and the careful selection of technology based on clear objectives. The experiences of Estonia, the global Health Data Collaborative, and Genentech provide valuable insights and best practices for other entities looking to integrate digital health technologies into their operations.

Future Directions

The future of digital health is poised for significant transformation, leveraging advanced technologies and competencies to enhance healthcare delivery and patient outcomes. Key areas of focus include the integration of wearable and at-home devices, virtual hospital wards, and remote diagnostics, which will revolutionize how physicians provide care, meeting patients in their preferred environments. Data-driven approaches, particularly in women's health, are expected to provide integrated, end-to-end care pathways. Additionally, the emphasis on mental health and well-being will grow, with digital tools playing a crucial role in delivering specialized solutions (31).

Technological advancements will continue to bridge care gaps and eliminate geographic barriers, making healthcare more accessible, especially to underserved populations. Retail healthcare models, such as those developed by Walgreens and CVS, are anticipated to evolve, offering alternative care models and contributing to the health ecosystem. Collaboration with a network of partner companies, including those involved in data, infrastructure, cloud services, and device ecosystems, will be essential to harness the full potential of digital health technologies(32).

Nursing professionals, in particular, will need to adapt to the digital age by re-envisioning nurse-patient relationships. The rise of "do-it-yourself" health applications, telemedicine, and virtual consultations will require nurses to develop virtual care modalities that exploit internet and mobile technologies. This shift will likely extend to the use of virtual or augmented reality technologies and integration with smart home systems (33).

Medical education must evolve to incorporate digital health competencies, preparing future healthcare professionals for the digital landscape. This includes navigating ethical and legal dilemmas unique to digital health, early exposure to digital health in curricula, and adapting patient communication skills for remote healthcare delivery (33)The inclusion of digital health topics in medical education, especially those related to ethics, the patient-provider relationship, and the use of electronic health records, will be crucial (34).

As digital health technologies continue to evolve, the distinction between digital health and health in general may diminish, with digital health encompassing all aspects of health (35). This shift underscores the importance of preparing healthcare professionals to effectively use and contribute to the development of digital health solutions, ensuring equitable and efficient healthcare delivery in the digital age.

Conclusion

The exploration of "Digital Competence in Healthcare: Bridging Professional Practice and Technology for Improved Patient Care" reveals a dynamic interplay between digital innovation and healthcare delivery, emphasizing the transformative potential and existing challenges within this nexus. The review underscores the critical need for enhancing digital competencies among healthcare professionals to leverage technology effectively for patient care. While the impact of digital proficiency on healthcare outcomes is significant, it is impeded by various hurdles including infrastructural inadequacies, privacy concerns, and the inherent resistance to change within the healthcare sector.

Successful case studies, such as Estonia's e-health initiative, demonstrate the importance of cohesive government support, public trust, and robust infrastructure in realizing the full benefits of digital health technologies. These examples serve as beacons for other healthcare systems aiming to integrate digital solutions seamlessly into their services.

Looking forward, the landscape of digital health is set to evolve rapidly with advancements in wearable devices, remote diagnostics, and AI, reshaping healthcare delivery and necessitating a proactive adaptation by healthcare professionals. This review highlights the imperative for medical education curricula to incorporate digital health competencies, ensuring future healthcare professionals are well-equipped to navigate the digital healthcare landscape.

The integration of digital technologies in healthcare presents a promising avenue for enhancing patient care, contingent on addressing the existing challenges and preparing healthcare professionals for the digital future. As digital health becomes increasingly indistinguishable from healthcare at large, a collaborative, interdisciplinary approach involving continuous learning and adaptation will be essential for harnessing the potential of digital innovations in healthcare.

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